Short-Term Prediction Overview

Numerical Weather Prediction

Online data

Prediction model

Orography Roughness Wind farm layout

End user

GRID

TRADING

Short-Term Prediction Overview

Numerical Weather Prediction

Prediction model

End user

Image sources: DWD, WAsP, Joensen/Nielsen/Madsen EWEC'97, Red Electrica de España.
WP1: Coordination Datasets Benchmarks

Numerical Weather Prediction

Prediction model

Image sources: DWD, WAStP, Joensen/Nielsen/Madsen EWECS, Red Electrica de España.
WP2:
Forecast solution selection
Standard evaluation protocol
Benchmarks
Numerical Weather Prediction

WP3: Decision support
Best Practice in Use
Communication

End user

Prediction model
Timeline

• First phase 2016-2018.
• Phase II started 1 January 2019, until 31 December 2021.

• Half-yearly meetings, often with larger conferences:
  – 21/22 January 2020, Glasgow (UK)
  – 24/25 June 2020, Offenbach (DE), with German forecasters research platform
  – January 2021, ??
  – Summer 2021, ESIG Forecasting Workshop, ??
Wind power forecasts have been used operatively for over 20 years. Despite this track, there are still several possibilities to improve the forecasts, both from the weather prediction side and from the usage of the forecasts. The new International Energy Agency (IEA) Task on Forecasting for Wind Energy tries to organise international collaboration, among national weather centres with an interest and/or large projects on wind forecast improvements (NOAA, DWD, ...), operational forecasters and forecast users.

The Task is divided in three work packages. Firstly, a collaboration on the improvement of the scientific basis for the wind predictions themselves. This includes numerical weather prediction model physics, but also widely distributed information on accessible datasets. Secondly, we will be aiming at an international pre-standard (an IEA Recommended Practice) on benchmarking and comparing wind power forecasts, including probabilistic forecasts. This WP will also organise benchmarks, in cooperation with the IEA Task WakeBench. Thirdly, we will be engaging and users aiming at dissemination of the best practices in the usage of wind power predictions.
Handouts

- Handouts as quick overview of major results – 2 pages
Recommended Practice on Forecast Solution Selection

Part 1: FORECAST SOLUTION SELECTION PROCESS

1. EDITION 2018

Submitted to the Executive Committee of the International Energy Agency Implementing Agreement on...

Prepared as part of the IEA Task 36, WP 2.1.
Edited by: Corinna Mührlein, Gregor Giebel, Jakob Messner, Jeff Lerner, Craig Collier

Part 3: Forecast Solution Evaluation

1. EDITION 2018

Submitted to the Executive Committee of the International Energy Agency Implementing Agreement on 1st May 2018

Prepared as part of the IEA Task 36, WP 2.1.
Edited by: Corinna Mührlein, Gregor Giebel, John Zack, Craig Collier, Aidan Tuohy, Justin Sharp
Minute scale forecasting

- Slides available from workshop website
- Complete workshop on YouTube.

- How to use Lidars, Radars or SCADA for very short term forecasts
- 30 sec – 15 min.
- Workshop at Risø June 2018.
How to use Lidars, Radars or SCADA for very short term forecasts (30 sec – 15 min).

Workshop at Risø last week.

Minute scale forecasting slides available from workshop website and complete workshop on YouTube.
## Timescales for wind forecasts

<table>
<thead>
<tr>
<th>Min/sec</th>
<th>Hour</th>
<th>Day</th>
<th>Week</th>
<th>Month</th>
<th>Season</th>
<th>Year</th>
<th>Decade</th>
<th>Century</th>
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<td>Operators</td>
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<td>Engineering/construction</td>
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<tr>
<td>Traders</td>
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<td></td>
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<tr>
<td>Grid management</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Turbine manufacturers</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1: Timescales for the future of wind**
Error classification

WEProg (Jørgensen and Möhrlen) have an interesting scheme:
WP1: Coordination Datasets Benchmarks

End user

Numerical Weather Prediction

Prediction model

Image sources: DWD, WAasP, Joensen/Nielsen/Madsen EWEC'97, Red Electrica de España.
WP1 Meteorology

Lead:
- Helmut Frank, DWD
- Will Shaw, PNNL

Mission:
To coordinate NWP development for wind speed & power forecasting
WP1 Meteorology

- Task 1.1: Compile list of **available data sets**, especially from tall towers.
- Task 1.2: Creation of annual reports documenting and announcing **field measurement programs** and availability of data.
- Task 1.3: Verify and Validate the improvements through a **common data set** to test model results upon and discuss at IEA Task meetings.
### Task 1.1 Available Data Sets

Compile list of available data sets, especially from tall towers.

- **Aims:** NWP models need data to compare to, in turbine relevant heights > 50-200 m.

- **Task:** compile list of data sets, especially masts.

- **Partners:** DWD, FoxWind, ZSW, Danish partners, PNNL.

Please find a list of meteorological masts over 100 m and their accessibility below. If you know of more information, which could be used for wind verification, please send a mail to Helmut Frank, DWD.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Coordinates</th>
<th>Altitude Above MBL</th>
<th>Tower Height</th>
<th>URL</th>
<th>Contact</th>
<th>Data Policy</th>
<th>Data Format</th>
<th>Obs. Period</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caborum, NL</td>
<td>49°29' E, 51°57' N</td>
<td>-6.7 m</td>
<td>200 m</td>
<td><a href="http://www.cesar-observatory.nl/index.php">www.cesar-observatory.nl/index.php</a></td>
<td><a href="mailto:henk.kiem@baltim.com">henk.kiem@baltim.com</a></td>
<td>Cesar data policy</td>
<td>netCDF</td>
<td>2000-04-01 to previous month</td>
<td></td>
</tr>
<tr>
<td>Urmarden, NL</td>
<td>52°48' E, 3°43' N</td>
<td>9 m</td>
<td>92 m</td>
<td><a href="http://www.meteornet.nl/umrden/index.php">www.meteornet.nl/umrden/index.php</a></td>
<td><a href="mailto:verhout@ecm.nl">verhout@ecm.nl</a></td>
<td></td>
<td></td>
<td>Since 2012</td>
<td>Offshore North Sea</td>
</tr>
<tr>
<td>Risa, DK</td>
<td>12°06' E, 56°54' N</td>
<td>0 m</td>
<td>125 m</td>
<td><a href="http://rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/765820">rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/765820</a></td>
<td>Allan Veitch</td>
<td>Ask nicely</td>
<td></td>
<td>1995-11-29 - 2015-01-28</td>
<td>Data measured since 1995; some months break in 2006.</td>
</tr>
<tr>
<td>Østmark, DK</td>
<td>12°08' E, 56°54' N</td>
<td>0 m</td>
<td>250 m</td>
<td><a href="http://rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/75820">rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/75820</a></td>
<td>Yoram Eisenberg</td>
<td>Ask nicely</td>
<td></td>
<td>2015-01-28</td>
<td>Two 250m masts in 4.3 km distance, both instrumented.</td>
</tr>
<tr>
<td>Risa, DK</td>
<td>12°06' E, 56°54' N</td>
<td>0 m</td>
<td>125 m</td>
<td><a href="http://rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/75820">rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/75820</a></td>
<td>Allan Veitch</td>
<td>Ask nicely</td>
<td></td>
<td>1995-11-20</td>
<td>Data measured since 1995; some months break in 2006.</td>
</tr>
<tr>
<td>Østmark, DK</td>
<td>12°08' E, 56°54' N</td>
<td>0 m</td>
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<td><a href="http://rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/75820">rodos.dtu.dk/dodo/rodos/IProj/02Overview.wsas/AProjects02&amp;Ref=0/75820</a></td>
<td>Yoram Eisenberg</td>
<td>Ask nicely</td>
<td></td>
<td>2015-01-28</td>
<td>Two 250m masts in 4.3 km distance, both instrumented.</td>
</tr>
</tbody>
</table>
Task 1.2 List of Field Campaigns

Creation of annual reports documenting and announcing field measurement programs and availability of data.

- **Aim**: to find new data usable for further NWP development, and to coordinate new measurement campaigns (e.g. New European Wind Atlas, WFIP2).

- **Partners**: DWD, PNNL, DTU

- April 12, 2017

Helmut Frank (DWD), Will Smith (PNNL), Joel Cline (DoE)

Field measurement programs in 2016

Introduction

In IEA Wind Task 36 no experiments are made to compare Numerical Weather Prediction (NWP) models with observations. However, there are work packages trying to foster this comparison. Therefore, we compile a list of experiments which are particularly relevant for wind energy forecasting. We try to give a short description of the experiments and some information on the data.

Major Field experiments in 2016
Task 1.2 List of Field Campaigns

Field measurement programs in 2016

In IEA Task 36 ex experiments are made to compare Numerical Weather Prediction (NWP) models with observations. However, there are few packages truly to follow these campaigns. Therefore, we compile a list of campaigns which are particularly relevant for wind energy forecasting. We try to give a short description of the experiments and some alternative reference data.

Major Field experiments in 2016

Wind Forecasting Project 2 (WFIP 2) and Complex Flow

The project WFIP 2 [1] aims to improve NWP's storm track and mesoscale model performance and increase understanding of physical processes such as stability, turbulence, and low-level jets that affect wind energy generation in regions of complex topography such as coasts, mountainous, and canyons. The experiment takes place in the Colorado River Basin area in the southwestern USA. The model includes mesoscale, canopy, and mesoscale and mesoscale variability at complex flow including frontal passages, strong cross-barrier flow, mountain waves, topographic waves, cumulus outflow, and marine puff.

Experiments in the New European Wind Atlas (NEWA)

The New European Wind Atlas (NEWA) [2] will create a freely accessible wind atlas for Europe. To validate the models used for this project it includes several atmospheric flow experiments. An overview of the experiments is given by Niermeijer et al. [2012]. The experiments enable Doppler lidar systems to complement or replace meteorological masts. At the latest by the end of the focus European Wind Atlas project all data will become freely available for the scientific community.

Coastal experiment REME Phoenix et al. 2016 took place from November 2015 to February 2016 at the Orkney wind farm to measure offshore flow by wind lidar systems. It was followed by an experiment to investigate flow over heterogeneous roughness with horizontally varying wind farms. This experiment took place at the Duke University Project Oceanus area (51°46′14″N 71°19′56″E) in northern Japan.

In another experiment, a ship-based system developed by Fraunhofer IWE S, i.e., a Doppler lidar device installed on a vessel and supplemented by a motion monitoring and correction unit, is deployed to measure the wind along a regular ferry route between northern Germany and the Baltic countries across the Baltic Sea. A two-month-long field campaign took place in summer 2016 with measurements from the ferry between Bremerhaven and the island of Helgoland in the German North Sea.

Field experiment in 2017

WFIP 2 continues into 2017.

In February 2017 the main campaign of the ship-based experiment of Fraunhofer IWE S within REME started on the route between Kiel, Germany, and Heligoland. The big REME experiment will be the campaigns in Perriguel, in central Portugal from January to June 2017. Several US universities and research institutions will join this European group for this experiment. Sierra do Periguel is formed by two parallel ridges with Southeast-northwest orientation, separated by circa 1.5 km. A km long and 500-550 m tall at their summit. A preparatory for the large Periguel experiment took place in May-June 2015 (see Niermeijer et al. 2016).

References


DOI: 10.1098/rsta.2016.0180 (http://rstl.royalsocietypublishing.org/content/375/2016.0180)


DOI: 10.1098/rsta.2016.0180 (http://rstl.royalsocietypublishing.org/content/375/2016.0180)
Wind power prediction project list

This list shows a large number of (mostly publicly funded) research projects in short-term forecasting of wind power. The list is incomplete, as the emphasis was a) on current projects, and b) on projects collected from the Task participants. Even so, the list contains research projects from the last two decades worth 46 ME, with 32 ME public funding, though not all of this can be attributed to forecasting (e.g. the IERP Wind or RAVE projects).

If you have additions or comments, please send them to the operating agent, Gregor Giebel (greg/at/du.dk).

<table>
<thead>
<tr>
<th>Country</th>
<th>Project acronym</th>
<th>Full title</th>
<th>Sponsor</th>
<th>Total / Funded budget</th>
<th>Start - end date</th>
<th>Participants (IEA Task 36 members in bold)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>gndcast</td>
<td>Increasing supply reliability by using flexible weather and power forecast models based on stochastic and physical hybrid methods</td>
<td>German Federal Ministry of Economic Affairs and Energy (BMWi)</td>
<td>6 ME / 5.5 ME</td>
<td>Apr 2017 - Mar 2021</td>
<td>Fraunhofer IWE, German Weather Service, Amprion, TenneT, 50Hertz, (\text{Tennnet}), (\text{Inmogry}), (\text{Netze BW}), (\text{EnBW}), Enercon</td>
</tr>
<tr>
<td>EU</td>
<td>IntoGrid</td>
<td>Demonstration of INTElligent</td>
<td>European Commission</td>
<td>14.5 ME / 11.3 ME</td>
<td>1 Jan 2017 - 30 Jun 2020</td>
<td>EDP Distribution (Coordinator), ...</td>
</tr>
</tbody>
</table>


Wind power generation project list

This list shows a total number of studies published research projects in short-term forecasting of wind power. The list includes all relevant projects, and for projects published after the two years, the list includes projects whose integration with the national grid marked a milestone. 

If you have any comments, please send me to the operating agent.

Project title: "Large-scale floating wind power generation" in the United States. 

[Diagram showing various projects related to wind power generation]
WP2:
Vendor solution selection
Standard evaluation protocol
Benchmarks
WP2 Benchmarks

Lead:
Pierre Pinson, DTU Elektro
Jakob Messner, DTU Elektro
Bri-Mathias Hodge, NREL
Caroline Draxl, NREL
# Task 2.4 Test Cases

Set-up and dissemination of benchmark test cases and data sets.

- **Aim:** Set-up and dissemination of benchmarks.
- **Partners:** DTU Elektro, DTU Wind Energy, EDF, INESC TEC, SmartWatt, Prewind, PNNL.

<table>
<thead>
<tr>
<th>NAME</th>
<th>TYPE OF DATA</th>
<th>AREA</th>
<th>PERIOD</th>
<th>TEMPORAL RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE-Europe</td>
<td>Simulated aggregated generation and +1 to +24 hour forecasts for 1494 European regions based on ECMWF and COSMO analysis and ECMWF forecast data</td>
<td>Europe</td>
<td>2012-2014</td>
<td>1 hour</td>
</tr>
<tr>
<td>NREL WIND</td>
<td>Simulated generation and 1 day ahead forecast data</td>
<td>US</td>
<td>2007-2013</td>
<td>5 min</td>
</tr>
<tr>
<td>Testiki</td>
<td>Simulated generation and 1 day ahead forecast data</td>
<td>US</td>
<td>2012-2014</td>
<td>5 min</td>
</tr>
</tbody>
</table>

Contact:

- **Jakob Messner**
  - Postdoc DTU Electrical Engineering
  - +45 45 25 35 06

Lead:

- **Pierre Pinson**
  - Professor DTU Electrical Engineering
  - +45 45 25 35 41
Task 2.4 Test Cases

Setup and dissemination of benchmark test cases and data sets.

- Aim: Setup and dissemination of benchmarks
  - Partners: DTU, EDF, ENEL, EDF Energy, ABC, MIER, TEC, Brunel, PNNL, EDF

**Table: Task 2.4 Test Cases**

<table>
<thead>
<tr>
<th>Name</th>
<th>THW or Date</th>
<th>Area</th>
<th>Period</th>
<th>Functional Purpose</th>
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</thead>
<tbody>
<tr>
<td>THW1</td>
<td>2010-2011</td>
<td>Europe</td>
<td>1 hour</td>
<td></td>
</tr>
<tr>
<td>THW2</td>
<td>UG</td>
<td>US</td>
<td>2007-2010</td>
<td>5 min</td>
</tr>
<tr>
<td>THW3</td>
<td>UG</td>
<td>US</td>
<td>2004-2005</td>
<td>10 min</td>
</tr>
<tr>
<td>THW4</td>
<td>unknown</td>
<td>US</td>
<td>2009-2012</td>
<td>1 hour</td>
</tr>
<tr>
<td>THW5</td>
<td>unknown</td>
<td>US</td>
<td>2009-2013</td>
<td>1 hour</td>
</tr>
</tbody>
</table>

**Additional Information:**

- **Example:**
  - Download: Full data set can be downloaded as zip file. Generation and forecasts and meta data on location and aggregation are stored in CSVs. Additional to wind power data, the data set includes solar generation and power load data. More information can be found at [https://www.iaea.org/tecs/](https://www.iaea.org/tecs/)

- **Data Policy:** [Creative Commons Attribution-NonCommercial 4.0](https://creativecommons.org/licenses/by-nc/4.0/)

**NREL, WIND Toolkit:**

- Analysis & Downloads: choose either Wind Resource Data Download (Point) or Wind Resource Data Download (Box) and select points on the map for which you want data. A configuration window will pop up where you have to supply your contact data and select the data sources. After your query has been processed you will get an email with a download link. Forecast data can only be accessed through a special request.

**NREL, Western and Eastern Wind Integration data sets:**

- [see NREL WIND Toolkit](https://www.nrel.gov/wind/)

**GEC/Com 2012:**

- The full data set can be downloaded as additional data set of the paper [http://www.nrel.gov/docs/fy12osti/55565.pdf](http://www.nrel.gov/docs/fy12osti/55565.pdf). Wind power measurements are found in [windpowermeasurments.csv](https://www.nrel.gov/wind/) and forecasts for the different wind farms are stored in separate .zip archive wv_forecasts_xxx.zip. Further information can also be found on [https://www.beeg.com/g/2012/2013/](https://www.beeg.com/g/2012/2013/)

**GEC/Com 2014:**


**AEMO:**


*Updated by Gordon Bailey on 10 May 2017*
IEA Task 36 WP2.1
FORECAST SOLUTION SELECTION AND TRIAL/BENCHMARK EXECUTION

• **Purpose:**
  - Develop a global industry reference document to assist companies, governments, academics on how to select a forecast provider and conduct a benchmark or trial
  - Document best practices to yield a forecast that will provide the most value to the end-user
  - Ultimately, reduce renewable energy integration costs
IEA Task 36 WP2.1
FORECAST SOLUTION SELECTION AND TRIAL/BENCHMARK EXECUTION

• **June 2018 Status:**
  – First draft developed with input from experts in the field
  – WP2.1 Lead presented and received feedback from IEA ExCo in May 2018
  – Further input being solicited
IEA Task 36 WP2.1
FORECAST SOLUTION SELECTION AND TRIAL/BENCHMARKING

- Decision Support Tool to find best path for appropriate solution
- Summary trial/benchmark checklist for all end-users
- Appendices with
  - meta-, historical-, and real time-data details to make communication more efficient
  - Forecast file format sample
  - Questions to ask in RFI/RFP
- Detailed steps during the three main phases of a trial: preparation, during, and post-trial
WP3: Decision support
Scenarios
Best Practice in Use
Communication

Numerical Weather Prediction
Prediction model

End user

Image sources: DWD, WAsP, Joensen/Nielsen/Madsen EWEC'97, Red Electrica de España.
WP3 Advanced Usage

Lead:
George Karinotakis, Mines ParisTech
Corinna Möhrlen, WEPROG
Task 3.1: Use of Forecast Uncertainties in the Power Sector: State-of-the Art of Business Practice

**Purpose:**
- Get an overview of the current use and application of probabilistic forecasts in the power industry sector;
- Investigate how participants estimate and deal with uncertainties.

**Phase 1:** Collection of Information  
**Phase 2:** Analysis of Results  
**Phase 3:** Communication and Dissemination

Work-in-progress over 3 years
Use of Forecast Uncertainties in the Power Sector: State-of-the-Art of Business Practices

C. Möhrlein¹, R. J. Bessa¹, M. Barthod¹, G. Goretii², and M. Siefert⁴

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²INESC TEC, Porto, Portugal, Email: ricardo.j.bessa@inesctec.pt
³meteo’swift, Toulouse, France, Email: morgan.barthod@meteoswift.com
⁴Dublin Institute of Technology, Ireland, Email: gianluca.goretti@mydli.ie
⁵Fraunhofer IWES, Kassel, Germany, Email: malte.siefert@iwes.fraunhofer.de

Abstract—The work we present is an investigation on the state-of-the-art use of forecast uncertainties in the business practices of actors in the power systems sector that is part of the “IEA Wind Task 36: Wind Power Forecasting”. The purpose of this task is to get an overview of the current use and application of probabilistic forecasts by actors in the power industry and investigate how they estimate and deal with uncertainties. The authors with expertise in probabilistic forecasting have been gathering information from the industry in order to identify the areas, where progress is needed and where it is difficult to achieve further progress. For this purpose, interview questions were compiled for different branches in the power industry and interviews carried out all around the world in the first six months of 2016. At this stage, we present and discuss results from this first round of interviews and draw preliminary conclusions outlining gaps in current forecasting methodologies and their use in the industry. At the end we provide some recommendations for next steps and further development with the objective to formulate guidelines for the use of uncertainty forecasts in the power market at a later stage.

I. INTRODUCTION

The relevance of forecast uncertainties for wind power and other renewable energies grows as the penetration of these sources in the energy mix increases. Once a certain level of penetration is reached, ignoring the reliability of forecasts not only becomes expensive in terms of energy cost, roughly goes with wind speed to the power of three, and small errors and uncertainties are thus amplified and have an even higher impact compared to wind speed uncertainties. Weather development associated with fronts moving over large areas where wind is increasing rapidly over a short time are the most critical situations for a balance responsible party or a transmission system operator (TSO): it is under these circumstances that a deterministic forecast may be strongly incorrect and suppress steep ramping that can cause system security issues as well as large imbalances. Translated in the market, it means that there can be a sudden lack of power during a down-ramping event or too little flexible power that can be down-regulated fast and efficiently, which then results in curtailment. As long as the penetration level of wind is below 20% of generation, such uncertainty can usually be dealt with with a reasonable amount of reserves. As penetration increases, or in the case of island grids or badly interconnected grids, reserves and ancillary services grow above a desirable level. In order to get an understanding of the current state of use of uncertainty forecasts and to find the gaps in the understanding of uncertainties and the associated forecasting tools and methods, we have been carrying out a study with a combination of questionnaires and interviews, which will
Use of probabilistic forecasting

Open Access journal paper
48 pages on the use of uncertainty forecasts in the power industry

Definition – Methods – Communication of Uncertainty – End User Cases – Pitfalls - Recommendations

Broader paper on uncertainty forecasting

Prediction Models Designed to Prevent Significant Errors

By Jan Dobschinski, Ricardo Bessa, Pengwei Du, Kenneth Geisler, Sue Ellen Haupt, Matthias Lange, Corinna Möhrle, Dora Nakafuji, and Miguel de la Torre Rodríguez

IT IS THE NATURE OF Chaotic Atmospheric Processes That Weather Forecasts Will Never Be Perfectly Accurate. This天然fact poses challenges for users of weather forecasts in a number of applications, including industry, agriculture, and public safety. This paper describes a novel technique for forecasting uncertainty in weather forecasts, which can be used to improve the accuracy of weather predictions and reduce the risk of errors.

The State of the Art in Forecast Generation

Today, some forecast systems have been developed specifically to predict the power production of wind and solar farms, different wind farms, local transformer stations and subgrids, distribution and transmission grids, and entire countries. Some of these systems rely on numerical weather predictions (NWP) to calculate the expected production. The way to transform weather predictions into power forecasts depends on the user's application and the available plant configuration and measurement data. A set of historical weather data is available, and power plant operators can use it to train statistical and machine-learning techniques to automatically find a relation between historical weather forecasts and simultaneously observed power measurements. This is achieved by the use of a technique called the unit parameterization, which maps the forecasted power trajectory to the historical power measurements.

DOI: 10.1109/MPE.2017.2729100
Data Science for Environmental Modelling and Renewables
- A Massive Open Online Course -

PRESENTATION SLIDES
ESIG Forecasting Workshop

Session 8
Jethro Browell
(presented by Corinna Möhrlen)
June 2018
St. Paul, MN, USA
Data Science for Environmental Modelling and Renewables
A Massive Open Online Course
6 Weeks, Equivalent to 5 ECTS Credits

Course Outline
Week 1: Introduction
Week 2: R Bootcamp
Week 3: Patterns in temporal data
Week 4: Patterns in spatial, spatio-temporal and network data
Week 5: Open data, Citizen Science and Twitter
Week 6: Wind and Solar Power Forecasting
Week 6: Wind and Solar Power Forecasting

By the end of the week participants will be able to:

- Explain the principles of numerical weather prediction and make informed use of such data
- Produce basic deterministic and probabilistic wind and solar power forecasts
- Explain and apply the principles of forecast evaluation

Video Content

30-60 Minutes of video comprising a short lecture and interviews with forecast users.

Content Pages

1. Overview of the model chain: NWP → Physical/Statistical Model → Use and Evaluation
3. Tools and methods in R
4. Deterministic Wind Power Forecasting
5. Principles of Deterministic Forecast Evaluation
6. Deterministic Solar Power Forecasting
7. Introduction to Probabilistic Forecasting
8. Producing Probabilistic Forecasts
10. Best Practice for Users of Commercial Forecasts

University of Glasgow

Go-Live in September 2018

supported by IEA Wind
Statement for Diskussion

Teaching should include standards or guidelines and provide a deeper understanding of the underlying fundamentals.

Not having standards leaves teaching at
- fundamental principles
- missing knowledge on state of the art developments

Not having standards educates young professionals with
- very different skills
- no reference to relate new projects to
Wind power forecasting: IEA Wind Task 36 & future research issues

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Abstract. This paper presents the new International Energy Agency Wind Task 36 on Forecasting and invites to collaborate within the group. Wind power forecasts have been used operatively for over 20 years. Despite this fact, there are still several possibilities to improve the forecasts, both from the weather prediction side and from the usage of the forecasts. The new International Energy Agency (IEA) Task on Forecasting for Wind Energy tries to organise international collaboration, among national meteorological centres with an interest and/or large
Wind power forecasting: IEA Wind Task 36 & future research issues

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Journal of Physics: Conference Series, Volume 753, B. Wind, wakes, turbulence and wind farms

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Collected Issues

Nowcast (especially for difficult situations, thunderstorms, small lows, …)
Sub 1 hour temporal resolution
Meteorology below 1km spatial resolution
Stability issues, especially with daily pattern / (Nightly) Low level jets
Icing
Farm-Farm interaction / quality of direction forecast
Short-term ensembles
Ramps and other extremes
Spatio-temporal forecasting
Rapid Update Models (hourly, with hourly data assimilation)
Use of probabilistic forecasts and quality of the extreme quantiles
Do DSOs need different forecasts than TSOs?
Penalties for bad performance? Incentives for improved perf.?
Seasonal forecasting? What’s the business case?
Data assimilation (with non-linear Kalman filters, 4D Var, …)
For collaboration, contact:

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